

CHROMOSOME CYTOLOGY, POLLEN STRUCTURE, AND RELATIONSHIP OF *RETZIA CAPENSIS*¹

PETER GOLDBLATT² AND RICHARD C. KEATING³

ABSTRACT

A chromosome number of $n = 12$ is reported for *Retzia capensis*, and the pollen is described based on SEM and TEM studies. It is tentatively concluded that the recognition of the monotypic family Retziaceae is warranted. The family's closest affinity is with the Loganiaceae.

Retzia capensis Thunb. is an unusual and striking member of the sclerophyll flora of the Cape region of South Africa. The genus is monotypic and its relationships are poorly known. It is a shrub with ericoid leaves and has a flower with a well-developed corolla tube, five epipetalous stamens, and a bicarpellate superior ovary. These characteristics place it among the less specialized of the tubiflorous group of families, but its correct relationships and family position remain unsettled. It is most frequently assigned to the Solanaceae or Loganiaceae, or is considered a separate family, but its relationships to these families remain unclear. A study of pollen structure and chromosome cytology has thus been made in the hope that this information may help in learning more about its phylogeny.

METHODS AND OBSERVATIONS

CYTOLOGY

Buds of *Retzia capensis* were fixed in the field in 3:1 ethanol-acetic acid and subsequently anthers were squashed in lacto-propionic orcein. A chromosome number of $n = 12$ was obtained.

POLLEN STRUCTURE

Pollen specimens were acetolyzed prior to electron microscopy. TEM specimens were embedded in Luft's Epon 6:4. After sectioning the grains were stained in uranyl acetate and lead citrate and photographed on a Hitachi HS-8 transmission microscope. SEM specimens were critical point dried from an ethanol-Freon series and then coated with gold to 250–300 Å. Photographs were prepared on a Cambridge Steroscan scanning electron microscope.

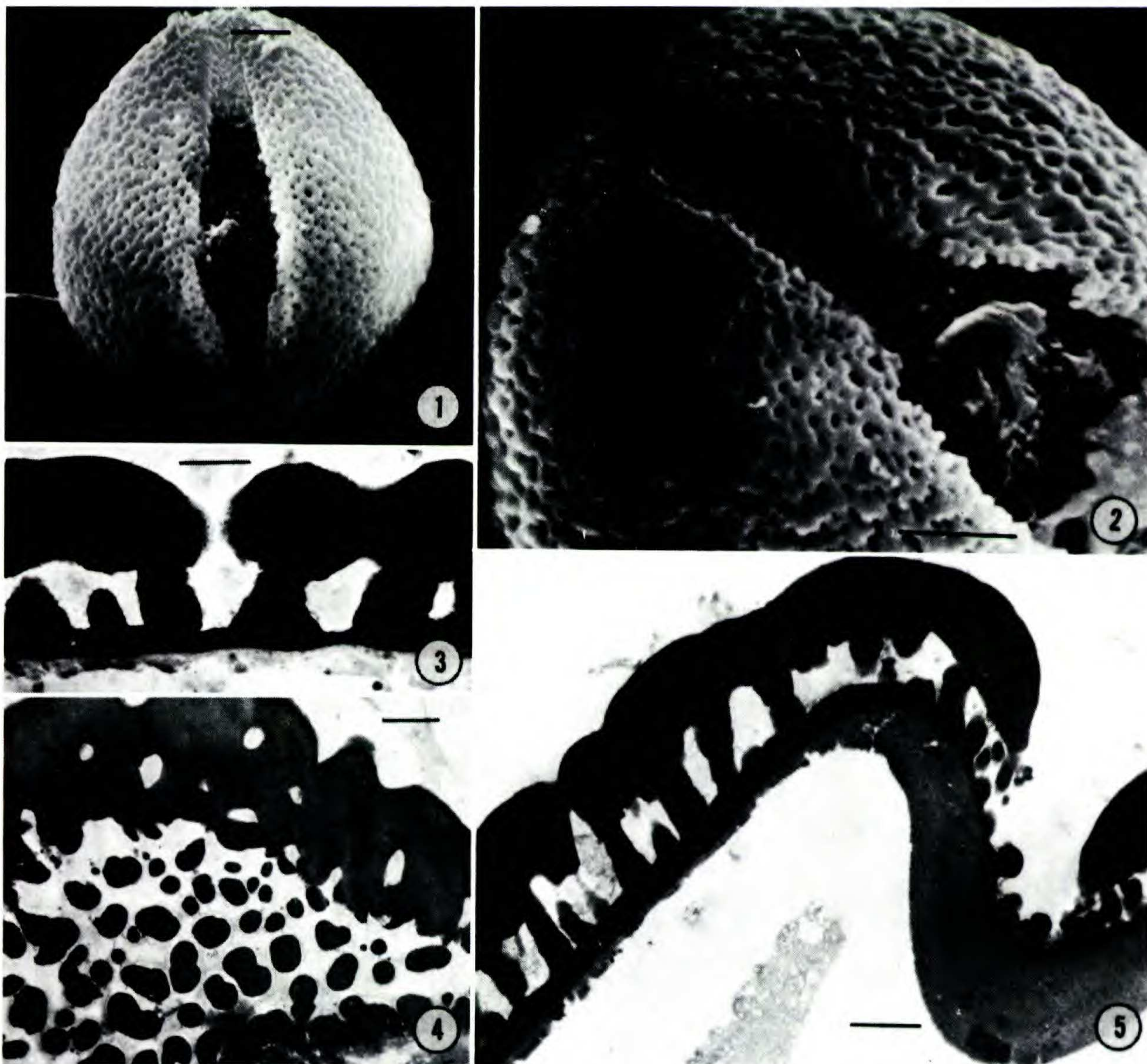
Pollen grains of *Retzia capensis* (Figs. 1–5) are spheroidal equatorially; circular to semiangular in polar view. The exine is microreticulate or microperforate-

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² B. A. Krukoff, Curator of African Botany, Missouri Botanical Garden, 2345 Tower Grove Avenue, St. Louis, Missouri 63110.

³ Department of Biological Sciences, Southern Illinois University, Edwardsville, Illinois 62025.

⁴ Collection data for material used in this study: *Retzia capensis* Thunb. SOUTH AFRICA. CAPE: Near Bettys Bay, *Raven 21630* (voucher material at MO).



FIGURES 1–5. Pollen of *Retzia capensis*, SEM and TEM views.—1. SEM equatorial view of pollen grain with aperture. Scale line = 5 μm .—2. SEM oblique surface view of microreticulate exine. Note sculpturing elements on the colpus surface. Scale line = 5 μm .—3. TEM cross section of exine. Scale line = 1 μm .—4. TEM tangential section through exine. Note muri, lumina, and cross sections of baculae. Scale line = 1 μm .—5. TEM cross section of exine. Note thickened endexine layer under colpus and free sculpturing elements on the colpus surface. Scale line = 1 μm .

tectate with lumina narrower than muri. Lumina 0.3–0.8 μm ; muri 0.8–1.8 μm . Exine thickness is 2.2–3.0 μm . Grains are tricolporate with an obscurely delimited endoaperture. Material exuding from endoapertures of acetolyzed grains was occasionally seen (Fig. 2).

Muri are simpli- or duplibaculate due to very irregular width of the muri. A well-defined foot layer is clearly demarcated from the endexine. Tectum 1 μm , infratectal space 0.8–1.0 μm , foot layer 0.4–0.5 μm .

The thickness ratio of the tectum: infratectal space (columellae): foot layer is 2:2:1. The ektexine: endexine ratio is 15:1. Columellae are circular or oblong in cross-section near their base and may become branched distally before attachment to the tectum. Costae (endexine) are 1.8 μm thick under the colpus.

Size of these specimens was $E = 30 \mu\text{m}$, $P = 35 \mu\text{m}$.

DISCUSSION

The affinities of *Retzia* have long been a point of disagreement among botanists. Early treatments allied the genus to the Solanaceae, Polemoniaceae, or Convolvulaceae, but most modern works consider *Retzia* to be related either to the Solanaceae or Loganiaceae. Endlicher (1836) first placed it in the Solanaceae, as did de Candolle (1852) and Bentham & Hooker (1876), who assigned it to the solanaceous tribe Cestreae, close to *Sessea* and *Metternichia*. Lindley (1836) first proposed a relationship with Gentianales (Contortae) placing *Retzia* tentatively in Apocynaceae. Fedde (1896) seems to have been the first to suggest a specific relationship with Loganiaceae and this perhaps gained widest acceptance in recent times (Thonner, 1915; Leeuwenburg, 1964; Dahlgren, 1975), though Hutchinson (1969) still places *Retzia*, as a distinct family, in Solanales, while Takhtajan (1968) treats *Retzia* as a family in Scrophulariales, following Buddleiaceae.

An important contribution to the understanding of *Retzia* and its affinities was made by Fedde (1896) who studied the anatomy of Solanaceae in detail. Fedde concluded that *Retzia* was not allied to this family, as it lacked intraxylary (internal) phloem, a universal feature of Solanaceae, has pubescence of a different type, and is heavily cutinized, a feature unusual in Solanaceae. Fedde's results have recently been confirmed by Herbst (1972) whose detailed morphological and anatomical work is unfortunately unpublished.

Anatomically, *Retzia* seems somewhat better allied with the Loganiaceae-Buddleioideae, as this subfamily lacks the internal phloem characteristic of other groups of the Loganiaceae (Metcalf & Chalk, 1950), while having comparable pubescence. Leeuwenberg (1964) admits a close affinity of *Retzia* with Buddleiaceae, but places it in a separate tribe. Herbst (1972) reaches a similar conclusion but prefers to retain separate family status for *Retzia*, placing it near Loganiaceae-Buddleioideae.

More recently, Jensen et al. (1975) have found important chemotaxonomic evidence relating *Retzia* to the limited group of orders which contain iridoid compounds. The orders in which iridoids occur include Gentianales and Scrophulariales, but notably not Solanales. Thus phytochemical data also points to the exclusion of *Retzia* from the Solanaceae. Unfortunately, the iridoid compound in *Retzia* has not been fully identified so that it is as yet not possible to use this chemical evidence for determining more detailed relationships of the genus.

The pollen structure, described by Punt & Leenhouts (1967), is confirmed, though we have noted a considerably smaller pollen size, $30 \times 35 \mu\text{m}$ as compared to $43 \times 45 \mu\text{m}$. The unremarkable, tricolporate grains are quite unlike *Sessea* and *Metternichia*, the two genera of the Solanaceae with which *Retzia* has been allied, but according to Punt & Leenhouts (1967) exhibit a resemblance with certain groups in the Loganiaceae, notably Gelsemieae, and, to a lesser degree, Buddleioidae.

Against this background, the haploid chromosome number of $n = 12$ in *Retzia* provides disappointingly little information. The same number, $x = 12$, is probably basic in the Solanaceae (Raven, 1975), but this concurrence is presumably co-

incidental and more advanced members of this family, including the Cestreae to which *Retzia* has been allied, generally have lower base numbers.

Loganiaceae, which appears to be a very heterogeneous alliance, has a wide range of chromosome numbers, and natural groups within the family are often accorded tribal, subfamily, or even family status. Loganioideae, including Antonieae, Strychneae and Loganieae, apparently has $x = 22$ (also with $x = 20$ in the last mentioned); Spigeliae evidently $x = 8$, though with $n = 10$ in *Cynoc-tonium*; Gelsemieae also $x = 10$ and 8 ; and Potalieae $x = 6$, in *Fagraea* and *Anthocleista*. The distinctive Buddleioideae stand out as having $x = 19$, though only three of the approximately ten genera in the alliance have been studied. This incidentally lends support to suggestions that this group is only indistinctly allied to the Loganioideae and perhaps merits separate family status. A close relationship of *Retzia* and Buddleioideae seems unlikely in view of the distinctive base number in this group, even accepting the anatomical similarities.

The most likely ancestral base number for Loganiaceae is tentatively suggested as $x = 6$, found only in the relatively unspecialized primitive Potalieae. In this light, *Retzia* might be considered an ancestral tetraploid, derived in the distant past from basic loganiaceous stock and perhaps from a line leading to the Buddleioideae. A relationship with Loganiaceae also seems reasonable in phytogeographical terms, in view of the good representation of Loganiaceae in the Africa-Madagascar region in contrast with the poor development of Solanaceae in Africa, where, with the exception of *Cestrum*, possibly recently introduced, only members of the widespread Solaneae occur, a tribe which is not at all related to *Retzia*.

With the evidence currently available on the affinities of *Retzia capensis*, it is fairly clear that it is allied to Loganiaceae; however, the relationship is by no means close, nor is it possible to relate it to any particular group in this family. Thus it remains a highly subjective decision whether to include it in Loganiaceae, but the evidence does seem to favor separate family status as Retziaceae.

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